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Two dimensional (2D) atomic crystals or nanosheets resulting from the exfoliation of inorganic layered materials constitute exciting nano materials with fascinating properties showing transparency, semi-conductivity and a lamellar liquid crystal (LC) phase that can be easily aligned at a macroscopic scale with weak magnetic or electric fields.[1] Stability and microstructure of these hybrid systems result from the interplay of the attractive and repulsive forces between the colloidal exfoliated nanosheets. A small variation in the intersheet molecular force balance caused by variations in nanosheet concentration, pH or ionic strength variation, may induce a re-organization in the system, for instance phase separation or aggregation via an exclusion mechanism.[2] Thus, while keeping its LC properties, the mixing between niobate nanosheets and alkylpoly(ethylene oxide) nonionic surfactants (C_nE_m) that self-organize in a variety of distinct morphologies such as hexagonal, cubic, lamellar lyotropic liquid crystalline phases represents a certain challenge.[3-4]

In this contribution, we show that combining $K_4Nb_6O_{17}$ niobate nanosheets and several alkylpoly(ethylene oxide) nonionic surfactants ($C_{10}E_5$ and $C_{12}E_5$) leads to interesting novel nanostructures. The introduction of the amphiphilic molecules does not lead to any aggregation of the inorganic nanosheets that still show LC phases. Nevertheless, nonionic surfactant systems constrains the characteristic repeat distance of the nanosheets lamellar phase, which singularly evolves following the density of surfactant whihc show a mono lamellar domain within the intersheets distance.[5]

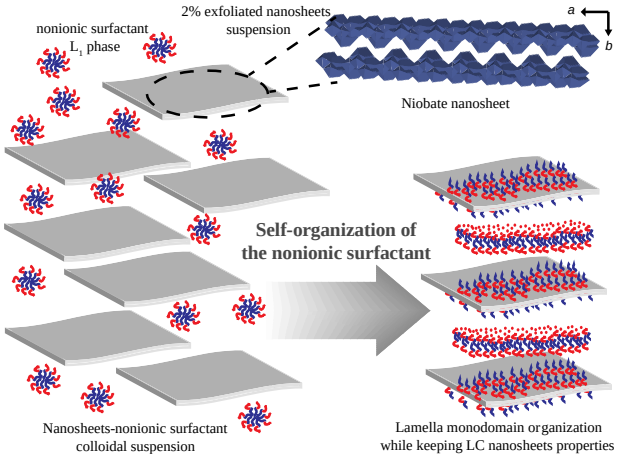

Fig1. Experimental protocol for the preparation of the colloidal suspensions resulting of the mixing of $K_4Nb_6O_{17}$ niobate nanosheets lamellar phase and various liquid crystalline phases (here L_1 phase) made of $C_{12}E_5$ nonionic surfactants.

1. F. Geng, R. Ma, A. Nakamura, K. Akatsuka, Y. Ebina, Y. Yamauchi, N. Miyamoto, Y. Tateyama, T. Sasaki, *Nat Commun*, **4**, 1632 (2013).
2. I. Grillo, P. Levitz, T. Zemb, *Eur. Phys. J. E*, **5**, 377 (2001).
3. R. Guégan, *Soft Matter*, **9**, 10913 (2013).
4. R. Guégan, *Langmuir*, **26**, 19175 (2010).
5. R. Guégan, K. Sueyoshi, S. Anraku, S. Yamamoto, N. Miyamoto, ChemComm DOI: 10.1039/C5CC08948D (2016).

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